



Preparing a framework for participatory modeling of seed system: development of cross-disciplinary ontology

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Title: “Preparing a framework for participatory modelling of seed systems: ontology’s development to cross the disciplines” Chile and Mali cases studies.

Agrobiodiversity, Seed System, Modelling, Society, Management

i. Background

In the centre of diversity of the crop plants, the cropping systems are still based on a broad range of genetic diversity, generated since domestication by farmers' knowledge in term of creation of varieties, and maintained during generations by the practices of management of seeds. Agrobiodiversity exists at three main levels of biodiversity; all three levels help sustain agricultural systems, as well as ensure their productivity. In response to global change, we focus on the definition and implementation of management practices adapted to the dynamic *in situ* preservation of genetic resources. Our general objective is to measure the impact of the methods of access to the seeds on the diversity of the genetic resources in agriculture. It aims to identify new forms of managing varietal diversity based on interaction at different levels of farmer, commercial, and institutional seed systems.

- **ii. Methods**

The project works in the field on two contrasting sites: i- on the one hand, the *in situ* conservation of traditional cereal diversity (pearl millet and sorghum) in West Africa; ii- on the other, the revival in Chili of Quinoa using *ex situ* collections. The proposed methodology is based on the joint construction of innovative tools - Agent-Based Models (ABM) - capable of integrating the points of view of different stakeholders and then simulating the dynamic aspects of biodiversity management in order to analyze the impact of future developments. The research deals with the structure of society, the way the farmers act, and where and how decisions are made to manage genetic resources. ABM models will be used to formalize the representation of the system that has been built from the data of each discipline, and to confront it to others in order to validate, enhance or refute this representation. The model will then evolve through a collective learning process involving the researchers, who gain access to a wide and integrated representation of the seed systems.

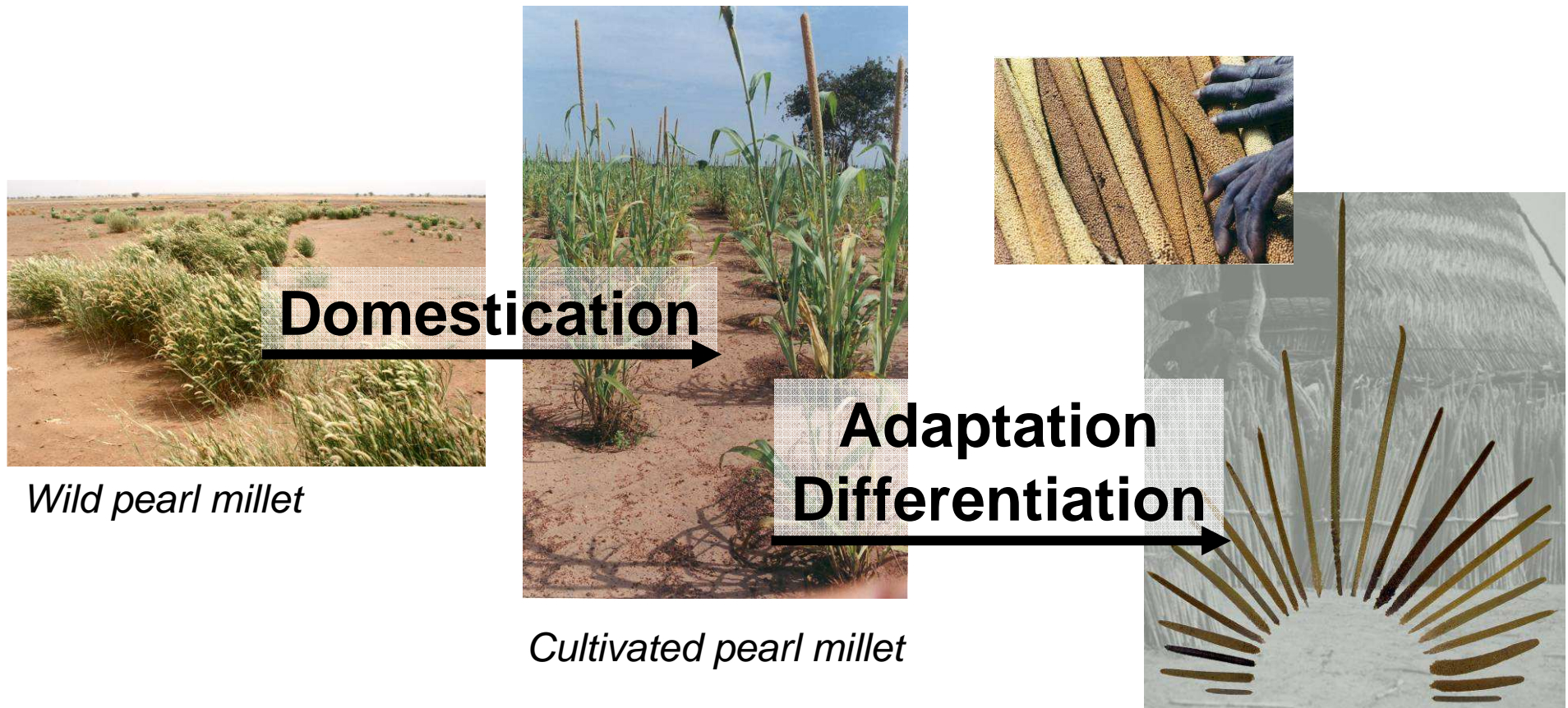
- **iii. Results**

The ABM's modelling process is to allow researchers of each discipline to express how they perceive the seed system by developing ontology's thematic. These buildings with various actors die a shared vision of the access to the seeds for the peasant (formal and abstract systems) to develop a generic model. The resulting shared representation is then used as a basis for discussing about new management rules and scenarios. The models are considered as tools of mediation which support the development of innovation and, to simulate the rules of operation of a seed system in various contexts.

- **iv. Conclusion**

The first results concerning ontology's of different social networks scenarios confirm that based on more information, which circulates between varieties, the farmer's social network determines methods of access to the seeds that impact on the diversity of the genetic resources in agriculture. Multi-agent simulation is meant to provide a common understanding of farmers' seed management. Model, with the ability to learn, will allow an increase in knowledge and procedural skills by learning from experience with disciplines. The prototype presented in this paper will be used during participative modelling sessions as a frame that will be fleshed out through the interactions with the researchers.

Crop infraspecific diversity : an invaluable asset created and maintained by world's farmers



Reasons for preserving/understanding in situ crop diversity on-farm

- Role in agroecosystem services
- *Ex situ* conservation of crop genetic resources is unable to preserve:
 - Adaptive mechanisms
 - All crop genetic resources
- Design innovative strategies for the release of improved or original genetic material

In situ crop infraspecific diversity has been shaped by flows of genetic material at multiple scales and levels

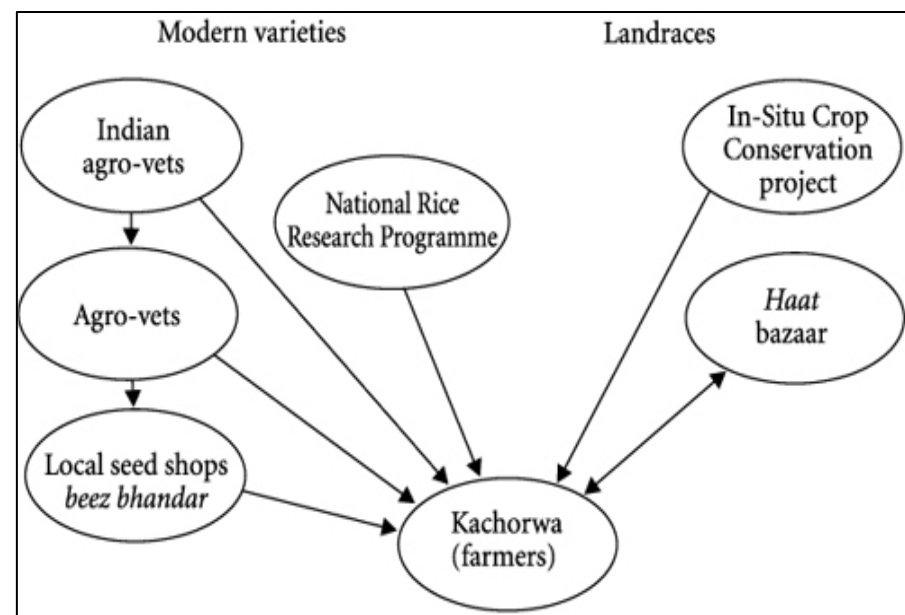
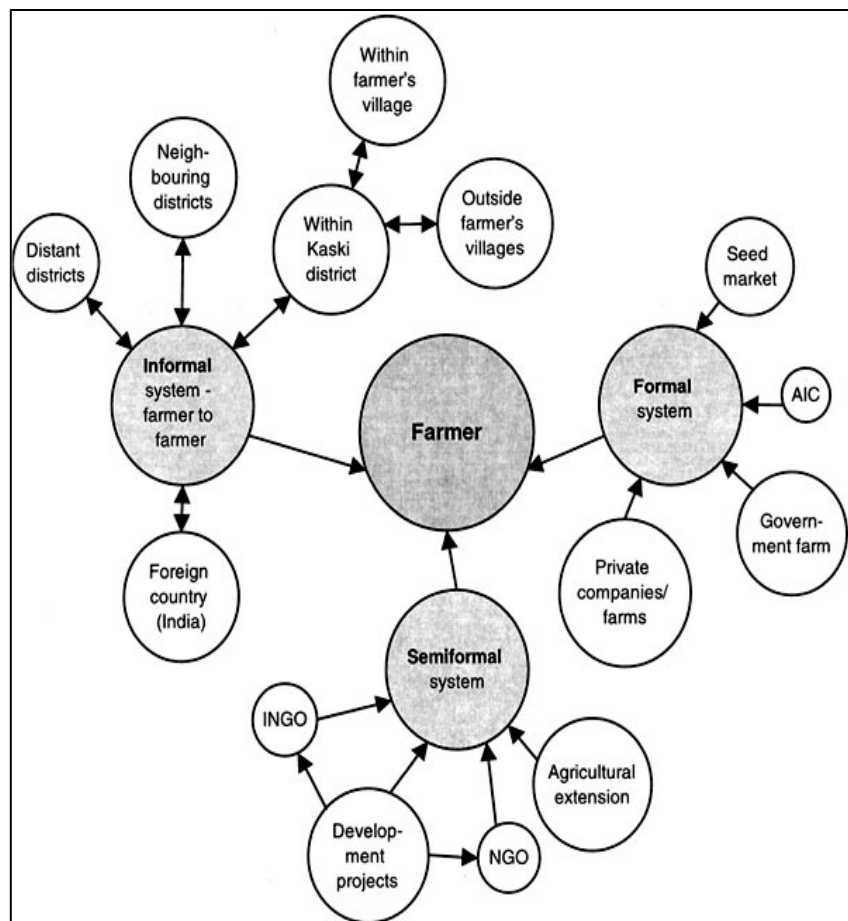
- Between continents through human migration
- From the wild to the cultivated compartment
- Between plants within a cultivated crop population
- Between cultivated populations
- Seed flows between farmers within a community
- Between farming communities
- From organisations (seed companies, research institutions, NGOs, ...) to farmers
- etc

The seed system



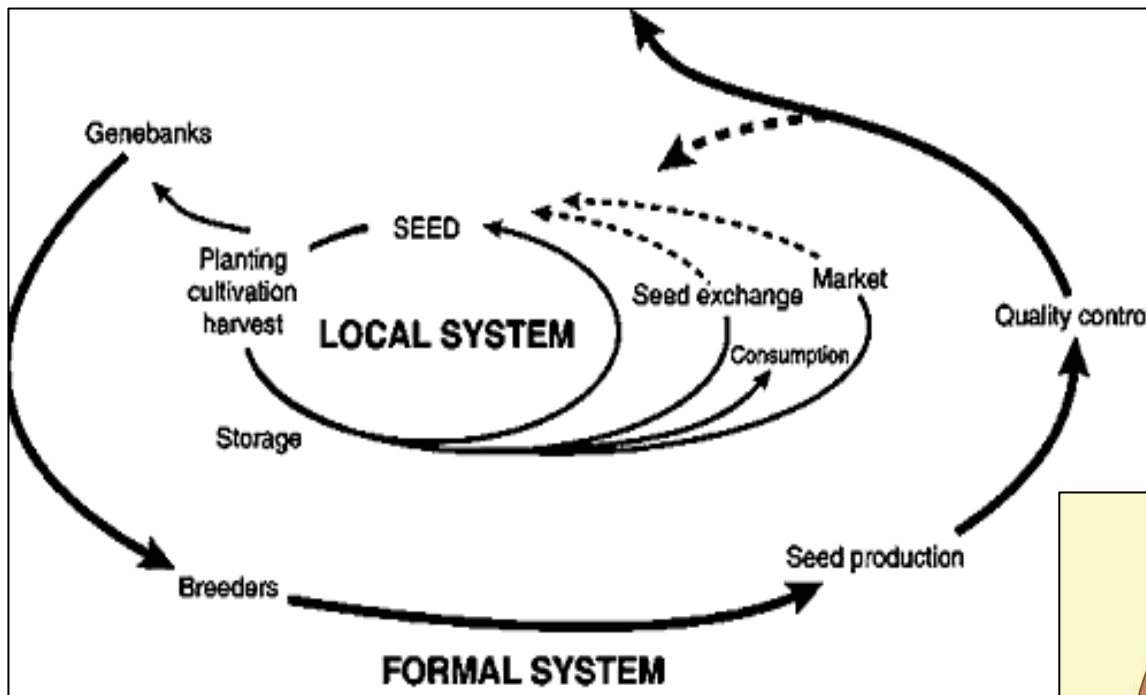
- The actors, their actions and interactions that impact crop diversity on-farm through seed management
- Different standpoints >>> Different representations





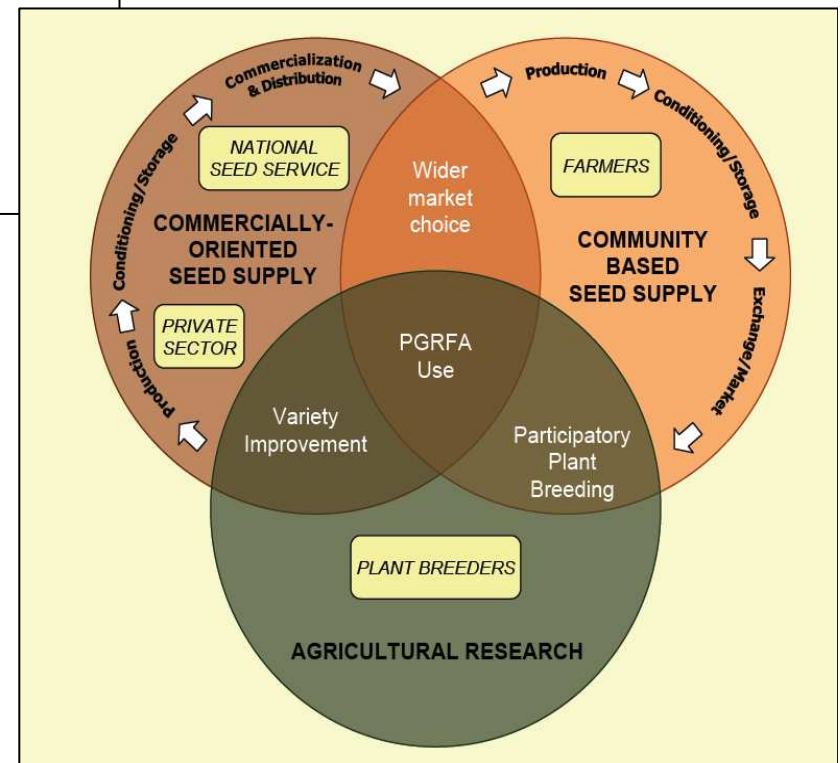
www.idrc.ca/en/ev-93077-201-1-DO_TOPIC.html

Baniya et al. 1999



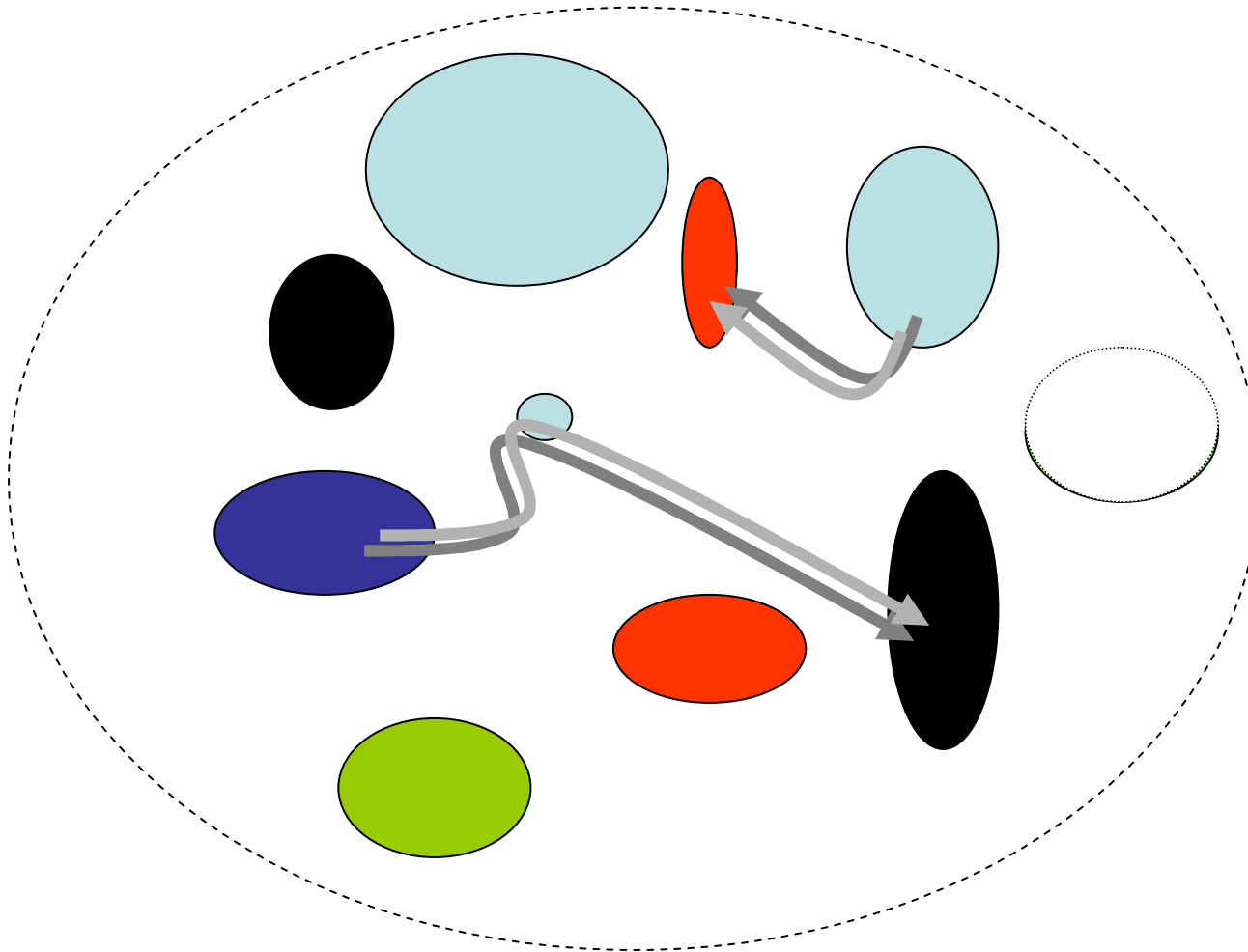
Sperling & Cooper

<http://www.fao.org/docrep/007/y5703e/y5703e06.htm>



Lecoent 2008

Diversity of crop landraces in an open metapopulation





Assumptions

Dialog between stakeholders is a key-factor for preserving crop diversity

- A cross-disciplinary analysis of seed systems is a prerequisite to develop facilitating tools

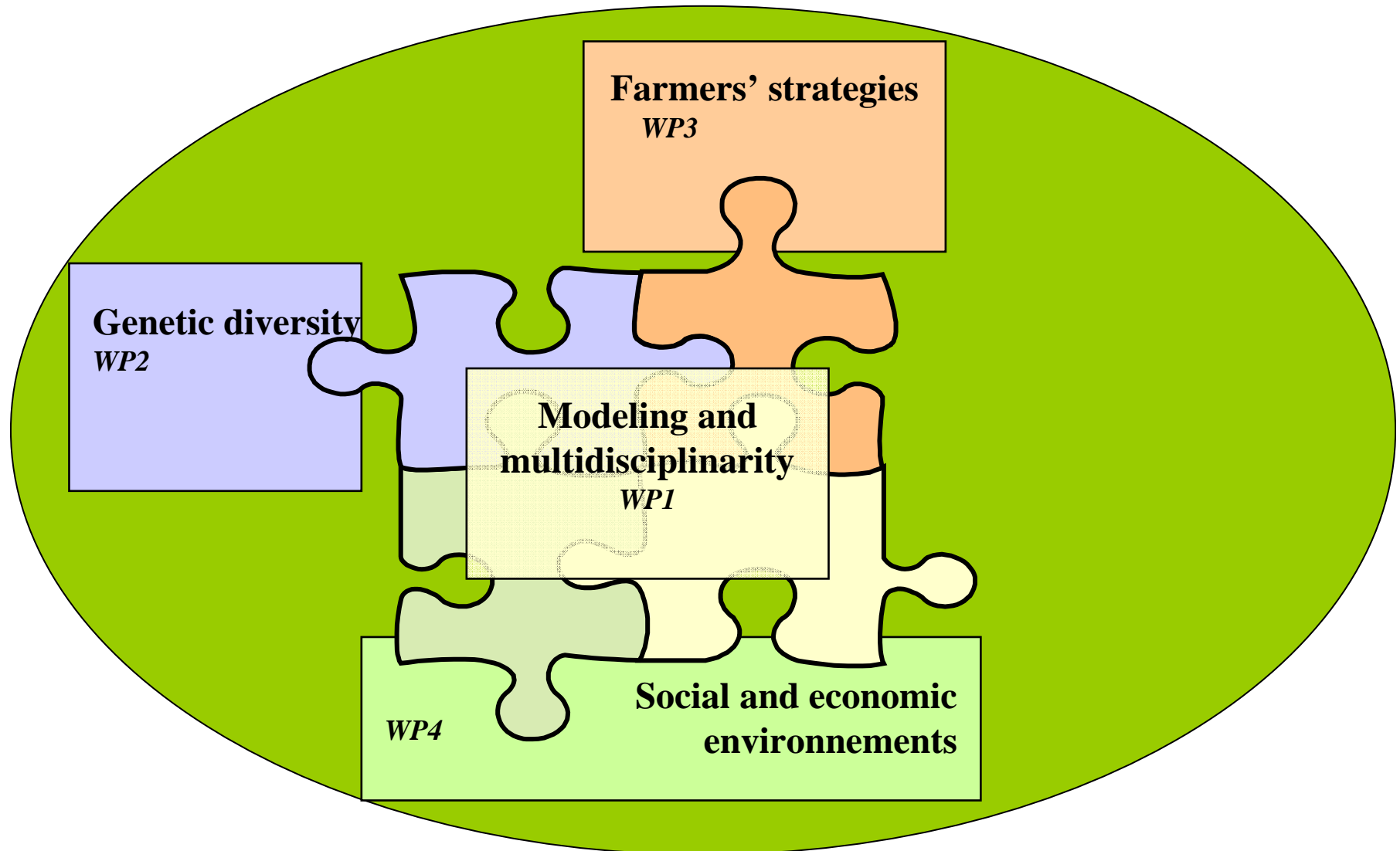
Approach

- Modeling the seed system
- Development of an Agent-Based Model (ABM) making possible to integrate distinct stakeholder perspectives and to simulate the dynamics of biodiversity

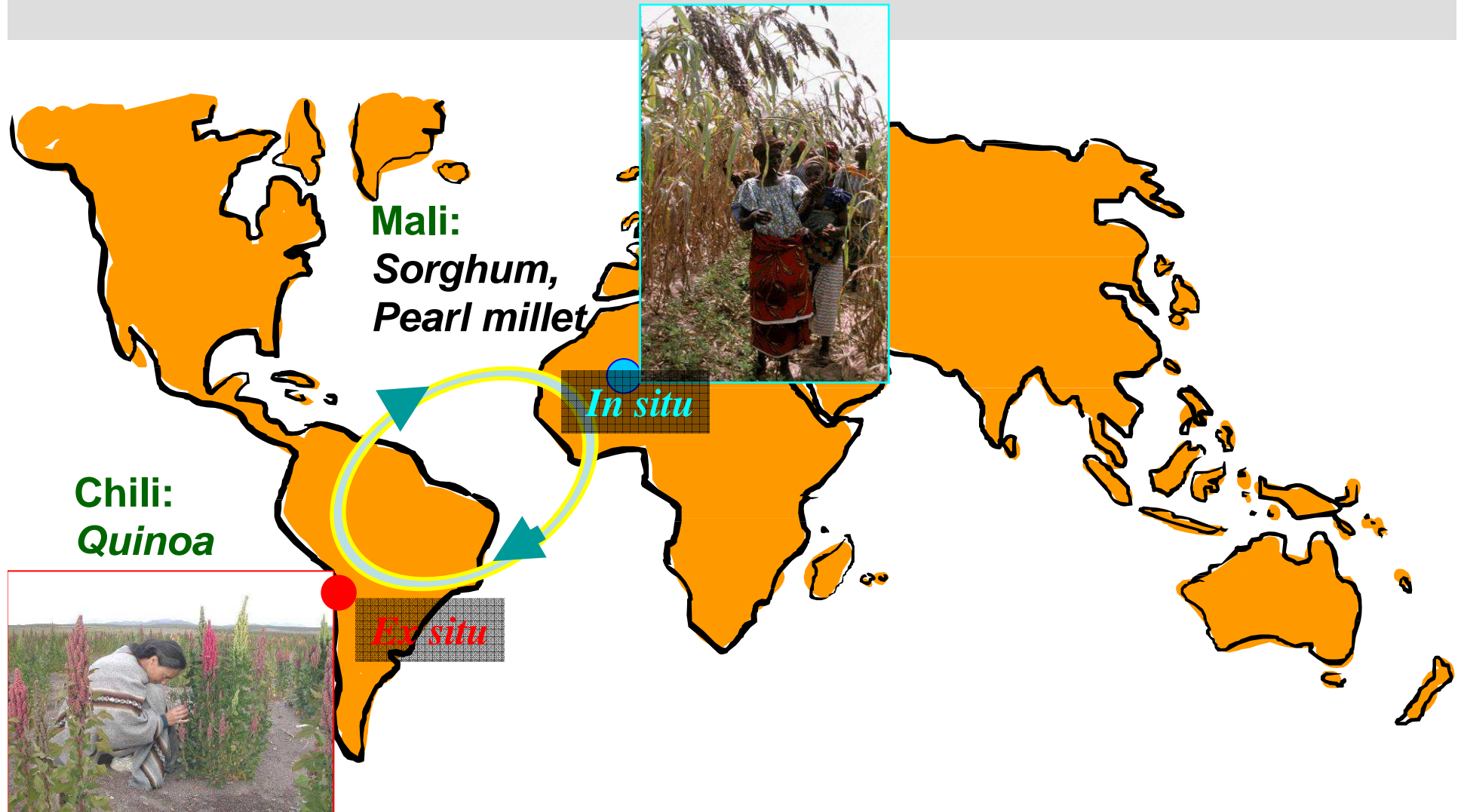
Objectives

- Identify interactions between the local, commercial and institutional seed system components
- Develop a generic model for seed systems
- Contribute to the dialog capacity between stakeholders in order to promote the maintenance and dissemination of a diverse portfolio of varieties

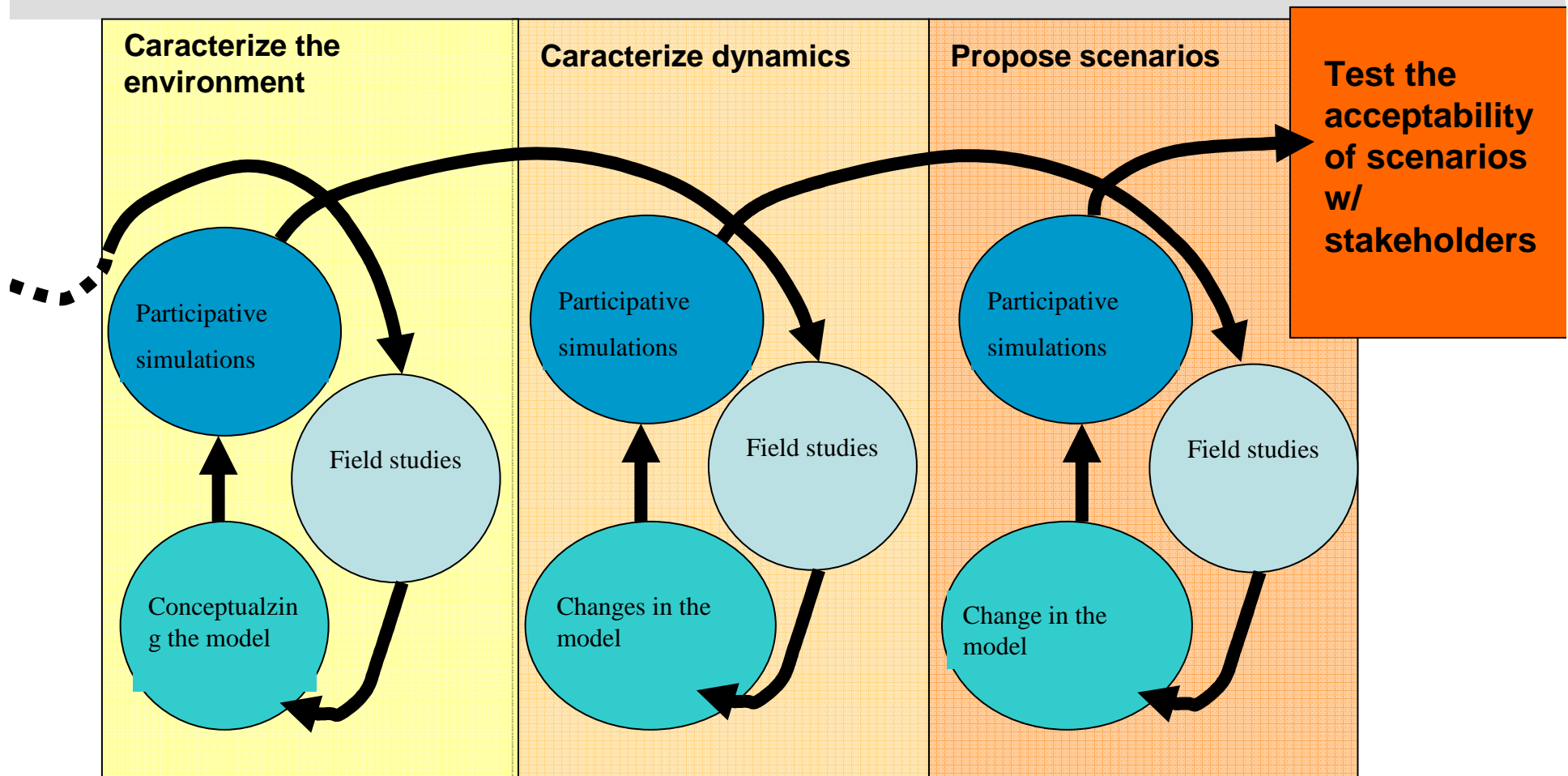
3 study levels >>> multidisciplinary



Two study situations with contrasting seed systems



An iterative research process that promotes multidisciplinary



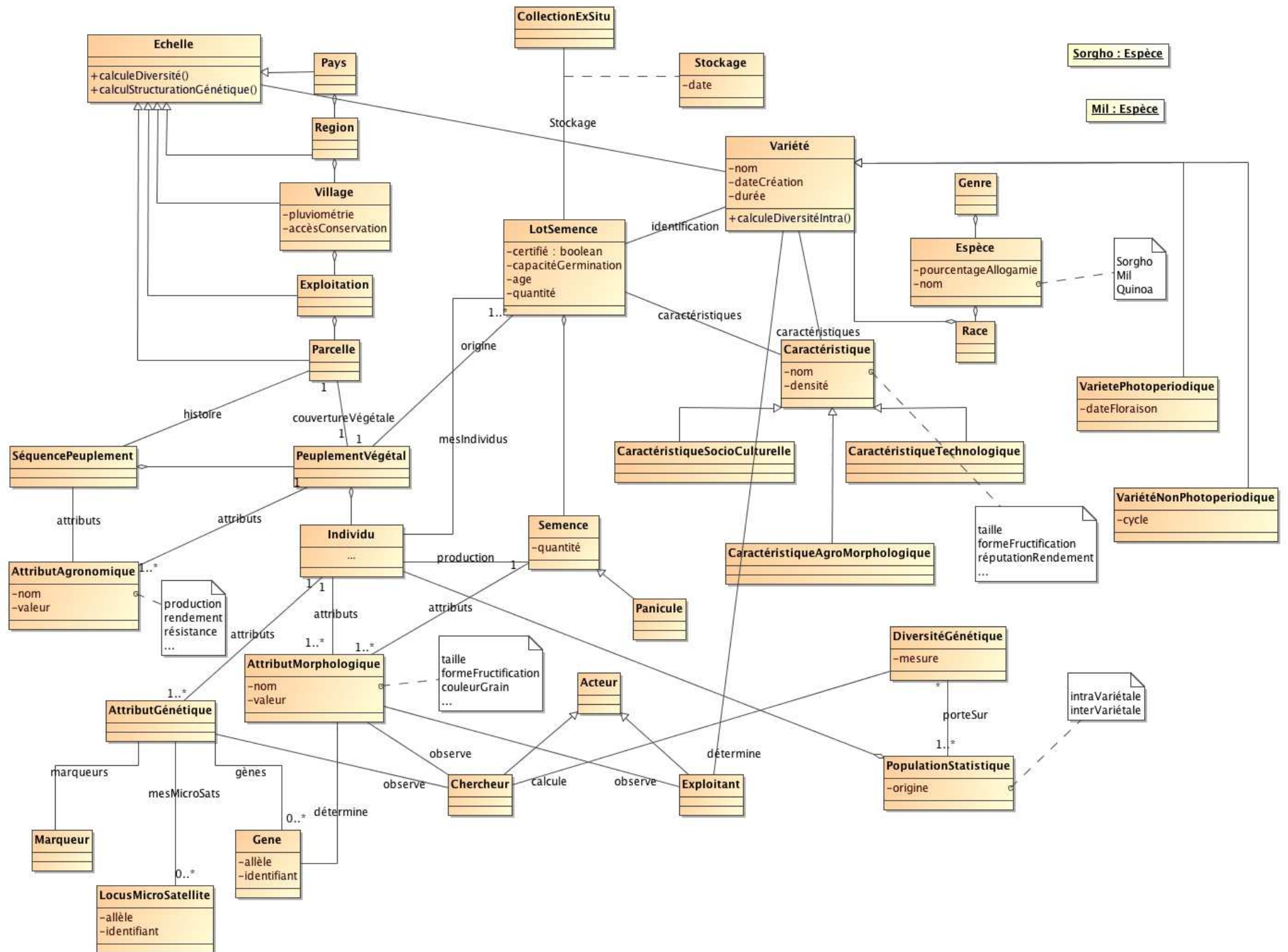
Building a shared conceptual model

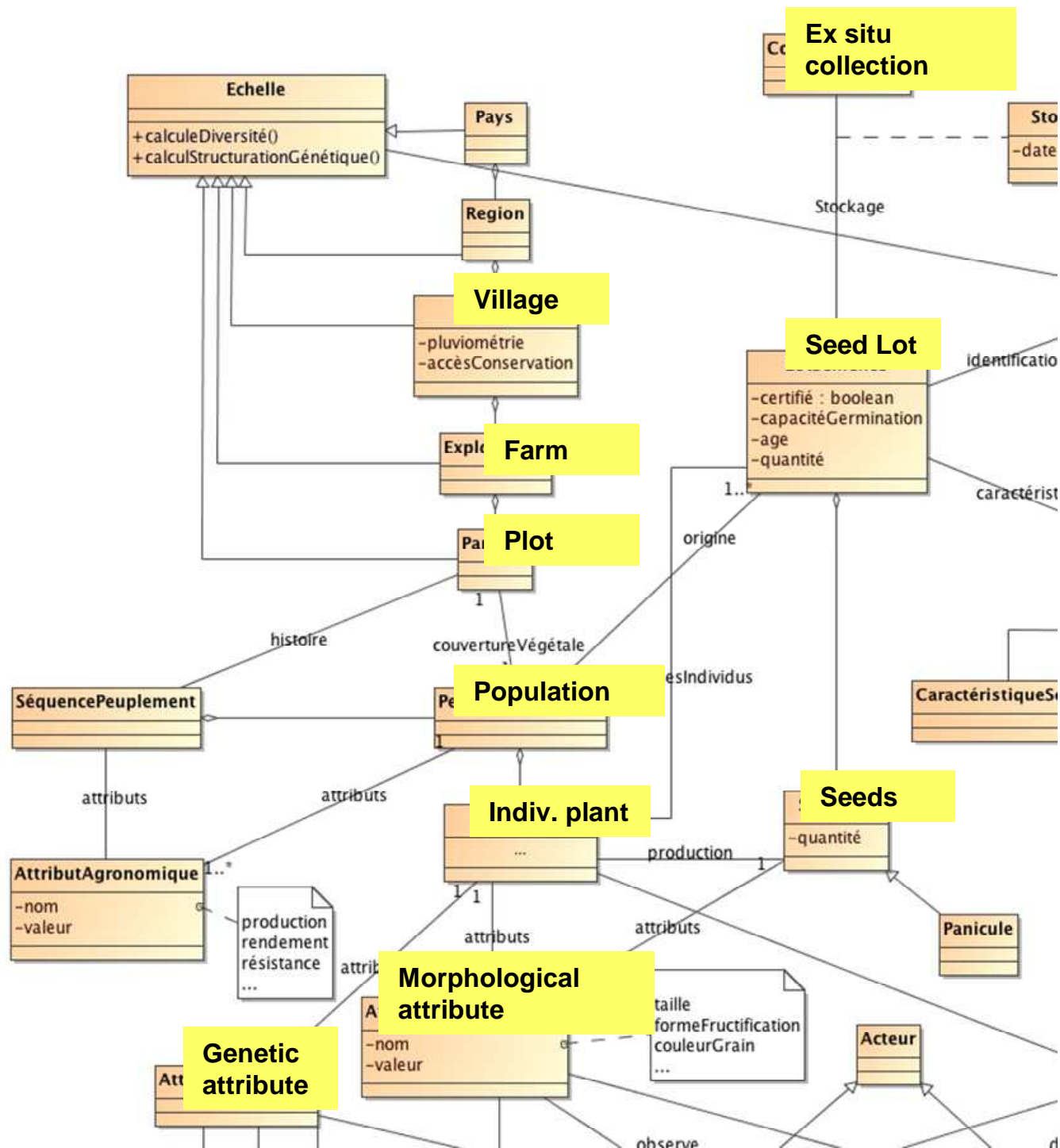
- Field surveys
- Multidisciplinary workshops
- Challenge = develop a language common to different disciplines in order to define :
 - Objects
 - Relationships between objects
 - Processes
 - Interactions
- Method : build a conceptual model using ontologies
 - The building process (on-going)
 - The model

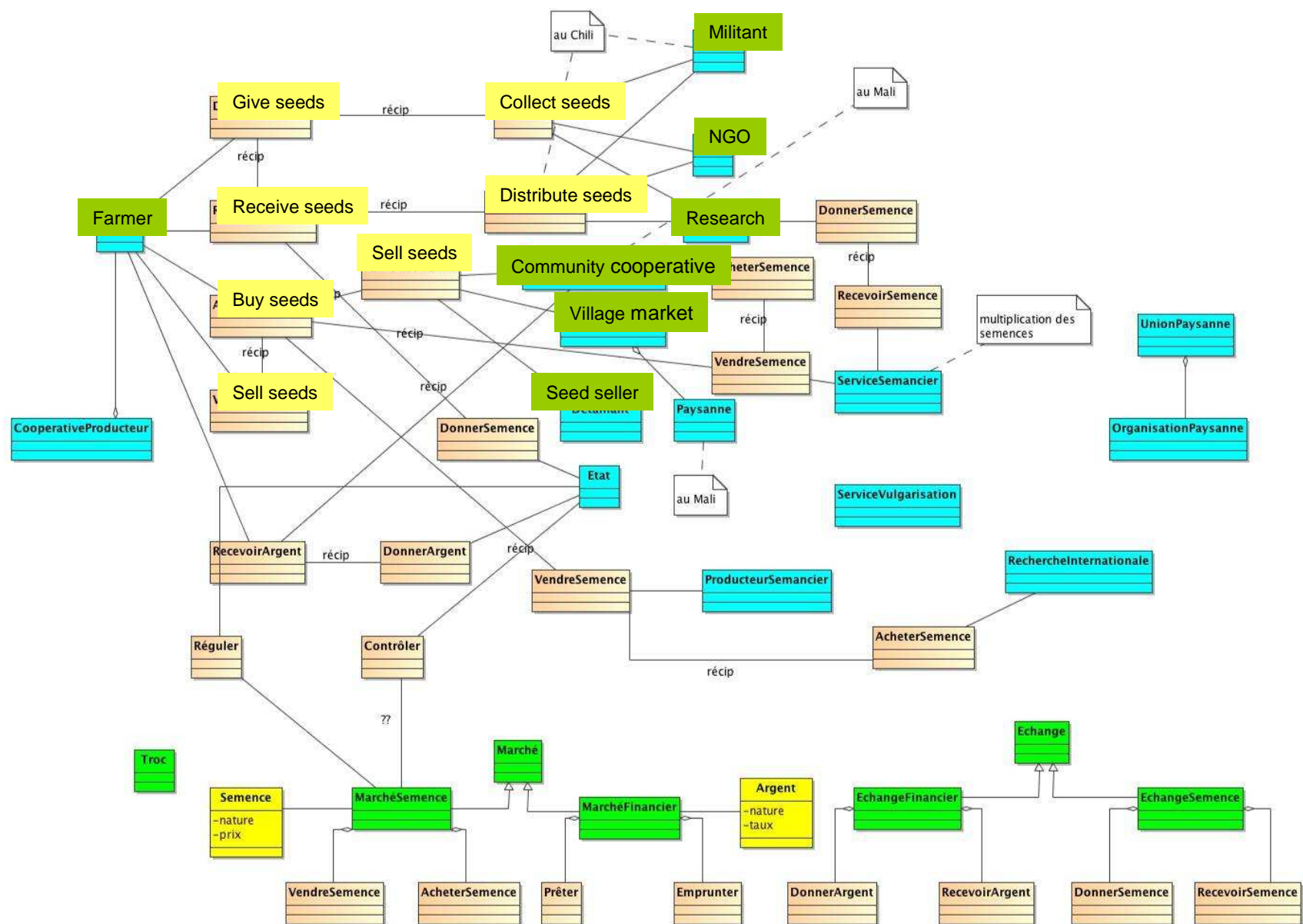


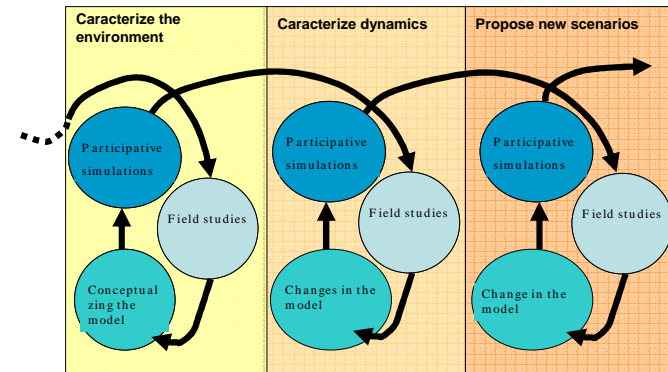
The ontologies

- In philosophy:
 - Domain of metaphysics about the nature of beings
- In computer science:
 - Specification of the conceptualization of a domain
 - **Conceptualization**: identification of pertinent objects, of their grouping in categories and of their relationships
 - **Specification**: formalization of this conceptualization
 - Set of concepts/classes/categories/types structured by taxonomic and semantic relations, describing individuals/objects/entities



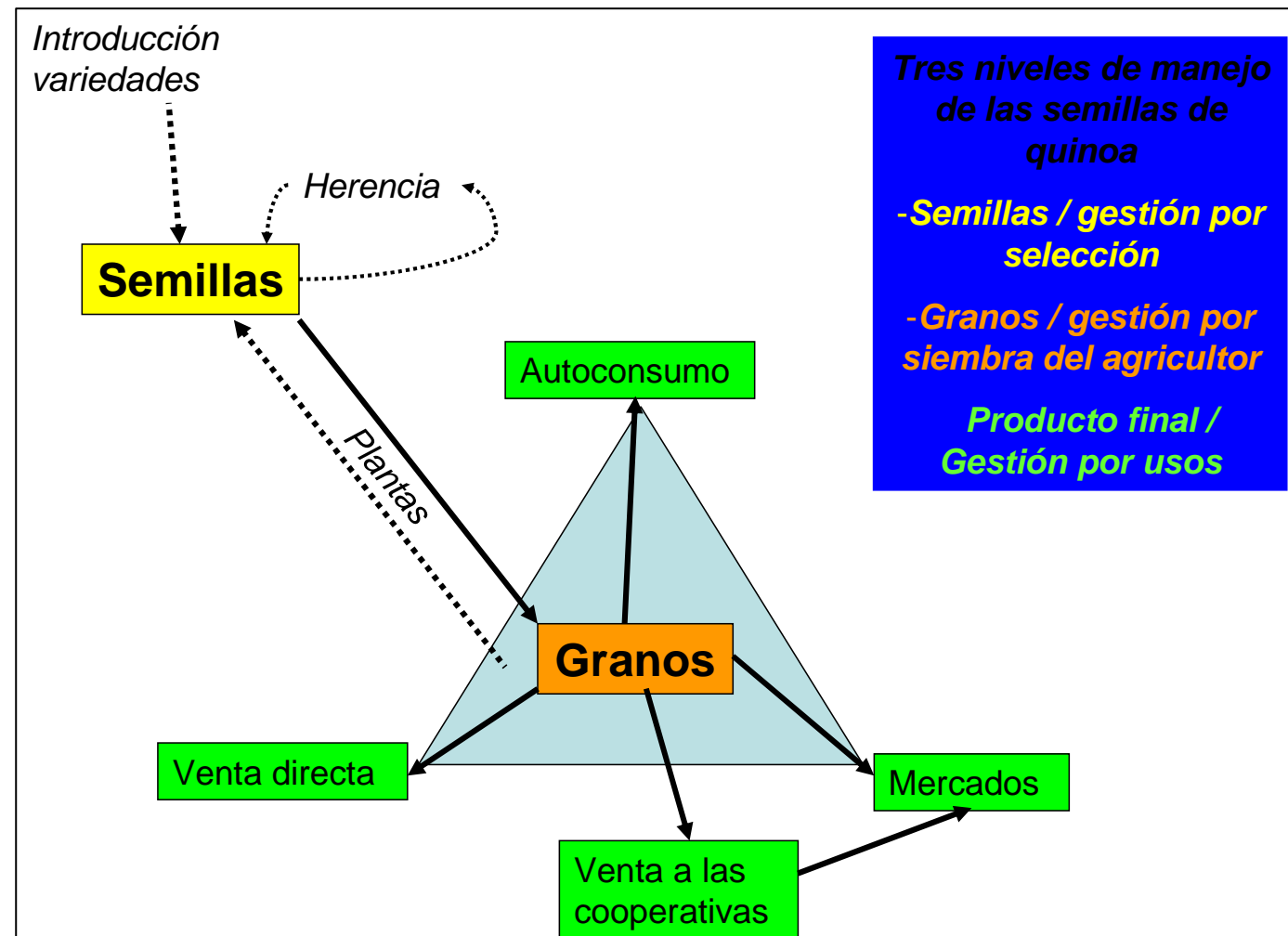




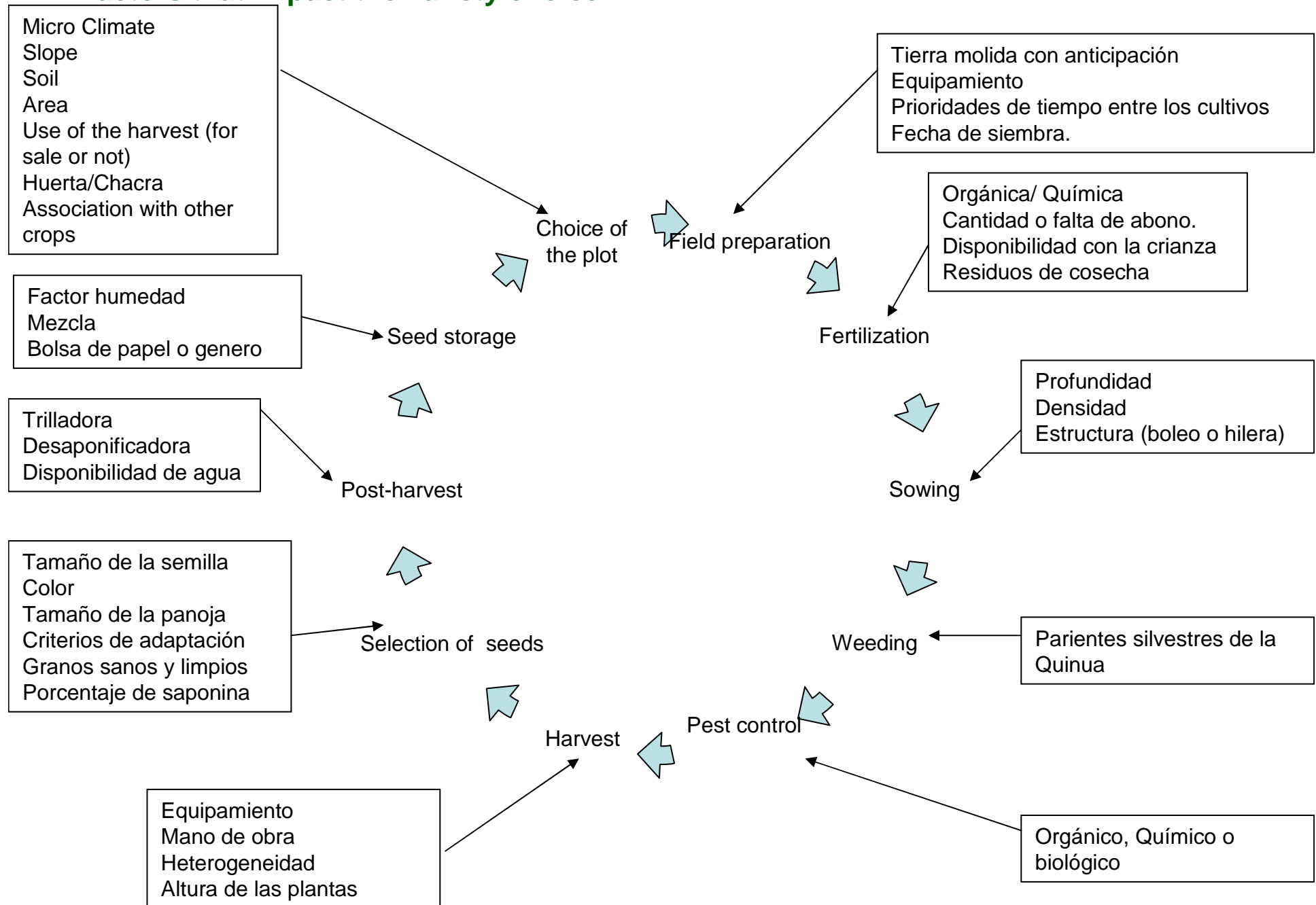


- First loop : allowed researchers to conceptualize their perception of the seed systems and to share it with researchers from other disciplines
- On-going:
 - Integration of representations to increase the genericity of the model
 - Use of the modeling process to identify knowledge gaps and design field studies

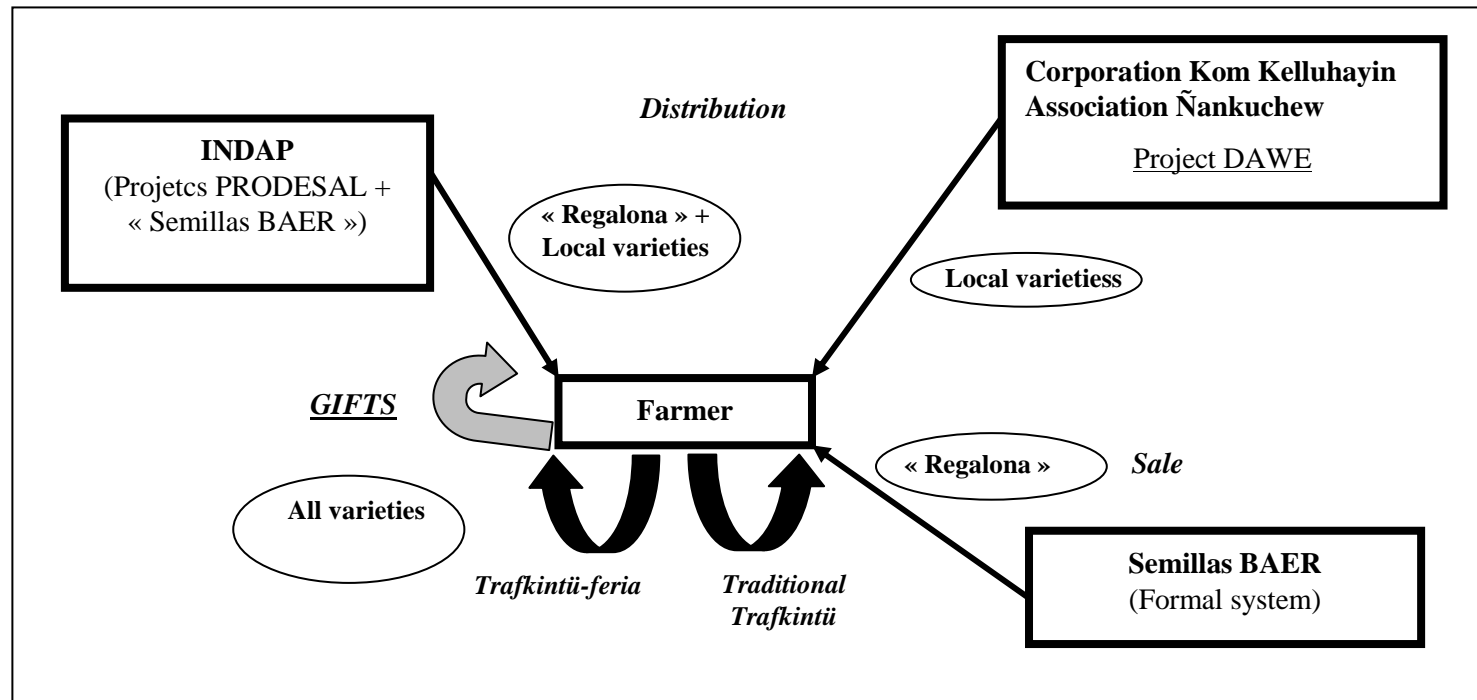
CHILE



From field preparation to seed storage : cultivation cycle of Quinoa (Chile) and factors that impact the variety choice



Quinoa seed flows – South Chile



Adapted from Julie Aleman 2009

Conclusion - Perspectives

- Cross-disciplinary ontology proved to be useful to improve communication and understanding between scientists coming from various disciplinary and cultural areas.
- Multi-agent simulation is meant to provide a common understanding of farmers' seed management.
- The model prototype will be used during participatory modeling sessions as a framework that will be nurtured through interactions with researchers and then with other stakeholders:
 - Validation : yes/no
 - Change /adjustment of the model



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Thank you